REMARKS

Reconsideration and allowance of the above-reference application are respectfully requested.

Upon entry of this amendment, claims 1-81, as amended, will remain in the application.

Claims 1-59 and 76 to 81 were rejected under the judicially created doctrine of obviousness-type double patenting as being allegedly unpatentable over claims 1-31 of U.S. Patent No. 5,700,333 to Yamazaki et al. Claims 1-16 and 76-77 were rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Yamazaki et al, and claims 17-59, 75, and 78-81 were rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Yamazaki et al. in view of Zhang et al. (U.S. 5,569,936).

Applicants teach forming a crystalline semiconductor layer in a thin film transistor from an amorphous semiconductor film using a catalyst, introducing an impurity selected from Group 15 into a selected portion of the surface area of the crystalline semiconductor layer, and removing a portion of the crystalline semiconductor layer containing that selected portion, along with the impurity, to form an island of crystalline semiconductor to be used as an active layer.

Yamazaki et al discloses a solar cell and photoelectric conversion device, not a thin film transistor.

Yamazaki et al. do not disclose implanting an impurity into a selected portion of the surface area of a crystalline semiconductor layer. The Action states that Yamazaki et al claim gettering a region or layer in claim 1 of that patent, and that this inherently means that an area or patterning of the gettering metal is found in the reference. Applicants submit that this is not the case, and that the Action misinterprets the meaning of the term "region" as used in Yamazaki et al.

The Action interprets "region," as used in Yamazaki et al, to mean a surface area of the crystalline silicon layer. However, the reference specifically defines the region formed by implanting the impurity in terms of depth ("0.1 to 0.2 μm depthwise"), not surface area (col. 6, ll. 43-46). The reference discloses implanting phosphorous ions using a plasma doping method to form the depthwise region in the crystalline silicon layer (col. 6, ll. 38-41). There is no indication that certain areas of the surface of the crystalline silicon layer are masked such that selected surface areas of the crystalline silicon layer are not implanted with the phosphorous ions. Accordingly, the entire surface of the crystalline silicon layer is implanted to form a depthwise (top) region in the layer, and this top region is subsequently removed. As such, no islands

would remain after removal of the top region over the entire surface of the crystalline silicon layer.

Zhang et al. is merely cited for its disclosure of using lasers to crystallize amorphous silicon.

Consider representative claim 1, as amended, which recites in relevant part:

"...introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the first and second portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element which promotes crystallization by a second heat treatment to the first portion of the crystallized semiconductor film; and

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film..."

Neither Yamazaki et al. nor Zhang et al., either alone or in combination, teach or suggest introducing an impurity selected from Group 15 into a selected portion of the surface

area of the crystalline semiconductor layer, and removing a portion of the crystalline semiconductor layer containing that selected portion, along with the impurity, to form an island of crystalline semiconductor to be used as an active layer. Accordingly, Applicants submit that claims 1-59 and 76-81 are allowable.

Attached is a marked-up version of the changes being made by the current amendment.

Applicant asks that all claims be allowed. Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 8/3/01

Scott C. Harris
Reg. No. 32,030

Fish & Richardson P.C.
PTO Customer No. 20985
4350 La Jolla Village Drive, Suite 500
San Diego, CA 92122
Telephone: (858) 678-5070
Facsimile: (858) 678-5099

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Version with markings to show changes made

In the claims:

Claims 1, 9, 17, 25, 45 and 52 have been amended as follows:

1. (Three Times Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

introducing into the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the first and second portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element which promotes crystallization by a second heat treatment to the first portion of the crystallized semiconductor film; and

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the heat treatment during gettering the element is performed in a temperature range not exceeding a glass transition point of the substrate.

9. (Three Times Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

selectively introducing into a first portion of the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film,

so that a crystallization proceeds from the first portion in a lateral direction to the insulating surface;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film while a third portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the second and third portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element second portion of the crystalline semiconductor film; and

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment during gettering the element is performed in a temperature range not exceeding a glass transition point of the substrate.

17. (Three Times Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

introducing into the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the first and second portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element by a second heat treatment to the first portion of the crystalline semiconductor film;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby

removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment during gettering is performed in a temperature range not exceeding a glass transition point of the substrate.

25. (Three Times Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

selectively introducing into a first portion of the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film, so that a crystallization proceeds from the first portion of the amorphous semiconductor film in a lateral direction to the insulating surface;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film after the irradiating step, while a third portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the second and third portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element by a second heat treatment to the second portion of the crystalline semiconductor film;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment during gettering is performed in the temperature range not exceeding a glass transition point of the substrate.

45. (Twice Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

introducing into the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not introduced with the impurity;

wherein the first and second portions of the crystalline semiconductor film are in contact with a same insulating surface over the substrate;

gettering the element which promotes crystallization by a second heat treatment into the first portion of the crystalline semiconductor film;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region; and

forming at least a source region and a drain region by doping an impurity into third portions of the crystalline semiconductor island,

wherein the second heat treatment during gettering is performed in a temperature range not exceeding a glass transition point of the substrate.

52. (Twice Amended) A method of manufacturing a semiconductor device <u>including at least a thin film transistor</u>, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate [having an insulating surface];

introducing into the amorphous semiconductor film an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not introduced with the impurity;

gettering the element by a second heat treatment into the first portion of the crystalline semiconductor film;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region;

forming at least a source region and a drain region by doping an impurity into third portions of the crystalline semiconductor island;

forming an interlayer insulating film comprising silicon over the gate electrode;

forming an interlayer insulating film comprising an organic resin film over the interlayer insulating film; and

forming a pixel electrode that is electrically connected to the source region or drain region through a contact hole over the interlayer film;

wherein the second heat treatment during gettering is performed in a temperature range not exceeding a glass transition point of the substrate.